

Space Weather Technical Forecast

Issued on Thursday, 07 April 2022 at 01:17 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: G1/Minor Geomagnetic Storms likely day 1 (7th) due to CME arrival. Active high energy electron fluence easing.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, with a few minor C-class flares, the most notable was a long period C3 from over the northwest limb around 06/1020 UTC. There are currently four sunspot regions on the visible disc with AR2986 and a new region in the southeast fading to plage during this period. AR2978 (Chi/Beta), in the southwest, is the largest region on the disc. It has shown some signs of decay but has also grown in length. However, it has remained relatively stable with no noteworthy activity. AR2981 has decayed and has lost the spots in its trailing group. It is now classified Axx/Alpha. AR2983 and AR2985 have also shown signs of decay in this period and both are now considered to be simple alpha regions.

No Earth-directed CMEs have occurred in the last 24 hours, although there are a number of filaments visible on the Earth-facing disc that are being monitored for any potential lift.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR at L1, has been at background or slightly elevated levels, with speeds between 380 and 440 km/s. The solar wind density was below average (<5 ppcc). The interplanetary magnetic field (IMF) strength, Bt, was weak, below 7nT, with the north-south component between -4 and +4 nT, but spent much the period in a negative (southward) direction. The Phi angle was mainly negative (towards the Sun). Geomagnetic activity was Quiet to Unsettled (Kp1-3).

Energetic Particles / Solar Radiation: The high energy proton flux (10MeV) measured at GOES-16 at GEO was at background levels. The high energy (greater than 2MeV) electron flux was at Moderate levels, but rose to High at 06/0930 UTC, with a peak of 3830 pfu at 06/1615 UTC. The 24-hour integrated fluence has been slightly above the Active threshold throughout with a gradual rising trend. 1.42e8 integrated pfu was recorded at 07/0000 UTC.

Four-Day Space Weather Forecast Summary

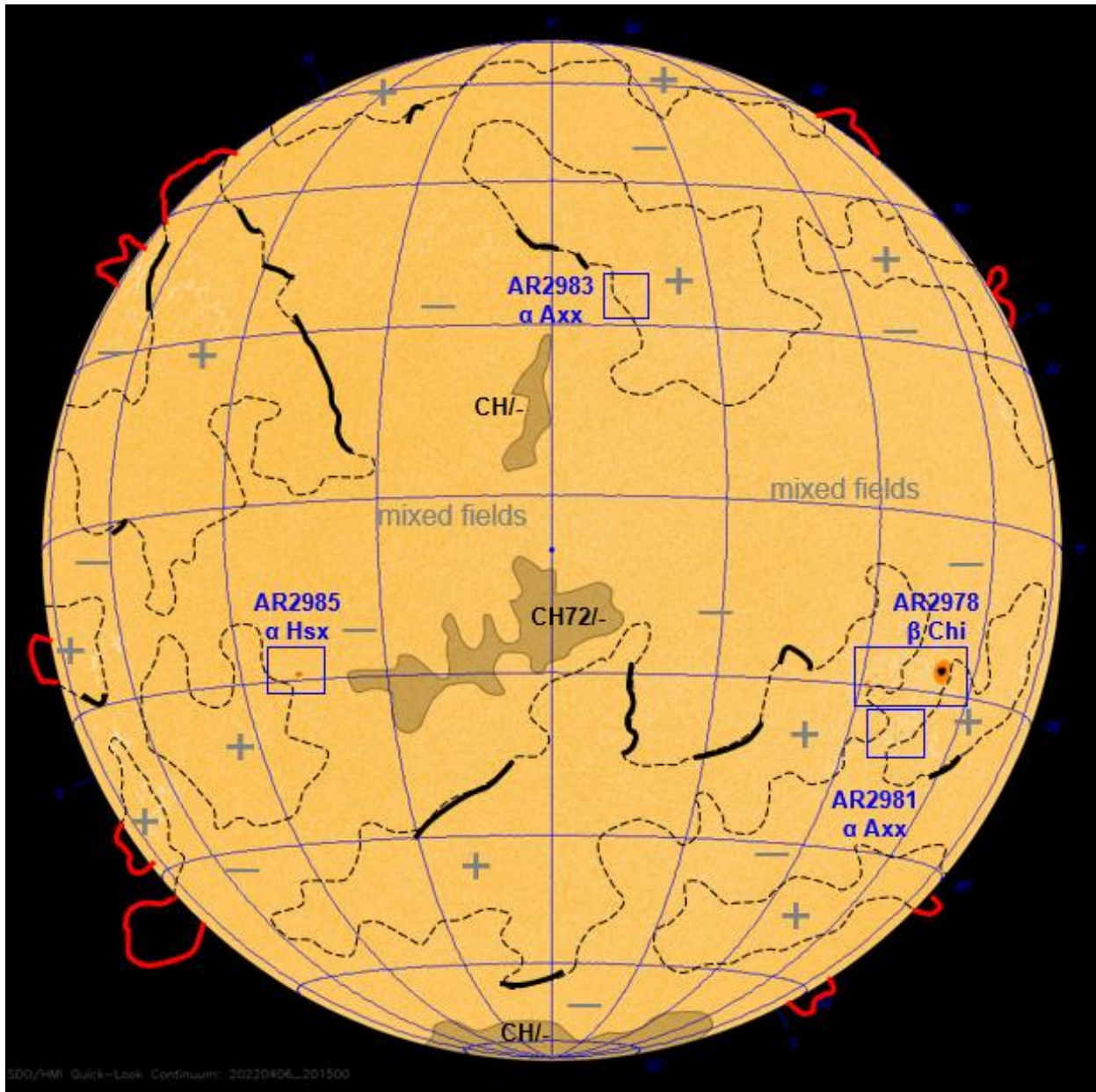
Solar Activity: Solar activity should be predominantly Low to Very low, with only relatively small and simple sunspot regions currently on the disc.

Solar Wind / Geomagnetic Activity: A CME which left the Sun due to a filament eruption around 03/1500 UTC is expected to arrive at Earth early on day 1 (7th), leading to a slightly elevated solar wind environment around Earth, easing day 2 (8th). Otherwise mainly background solar winds are expected until day 3 (9th), with the arrival of the fast wind of coronal hole 72, and a low chance of a glancing interaction from a further CME which left the Sun around 04/2200 UTC, although this is very low confidence. Geomagnetic activity is forecast to become Unsettled to G1/Minor Storm from the CME on day 1 (7th). Quiet to Unsettled activity returning on day 2 (8th), before a further enhancement to Unsettled to Active, with a chance of G1/Minor Storms occurs on day 3 (9th).

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Energetic Particles / Solar Radiation: The high energy (greater than 10MeV) proton flux is expected to persist at background levels, with only a very slight chance of slight increases. The high energy (greater than 2 MeV) electron flux is currently diurnally varying between Moderate to High but is expected to drop out with the arrival of the CME on day 1 (7th). Whilst a recovery in values is possible later in the period, this is likely to be to lower levels than currently observed. The associated 24 hour fluence is currently Active, but expected to fall below this level through day 1 (7th) and remain below for the rest of the period.

Figure 1. Solar Analysis Valid 06/2000 UTC.



Key: Filament ____, Prominence ____, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α - β - γ - δ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

There is an Earth-directed CME, which is expected to arrive at Earth at the start of day 1 (7th). This is from a filament eruption at 03/1500UTC, in the southeast disc. Whilst a limited shock is expected from the arrival, there is the potential for a dense magnetic cloud. This will give a likelihood of G1-G2 Minor to Moderate storms, depending upon the polarity and density of the cloud.

A second CME which had been assessed as potentially arriving on day 3 (9th) has now been reassessed as likely missing, passing mostly to the south and east of the Earth. There remains uncertainty with this analysis however, and a glancing interaction cannot be ruled out during the later part of day 2 (8th) into day 3 (9th).

Aside from the anticipated CME, solar winds are expected to be at background to slightly elevated, with the next coronal hole enhancement anticipated during the second half of day 3 (9th), from the arrival of the fast wind of CH72/-. Along with the slight chance of the above CME arrival, this will give a chance of further G1/Minor Storm intervals. Elevated solar winds are expected to continue through day 4 (10th).

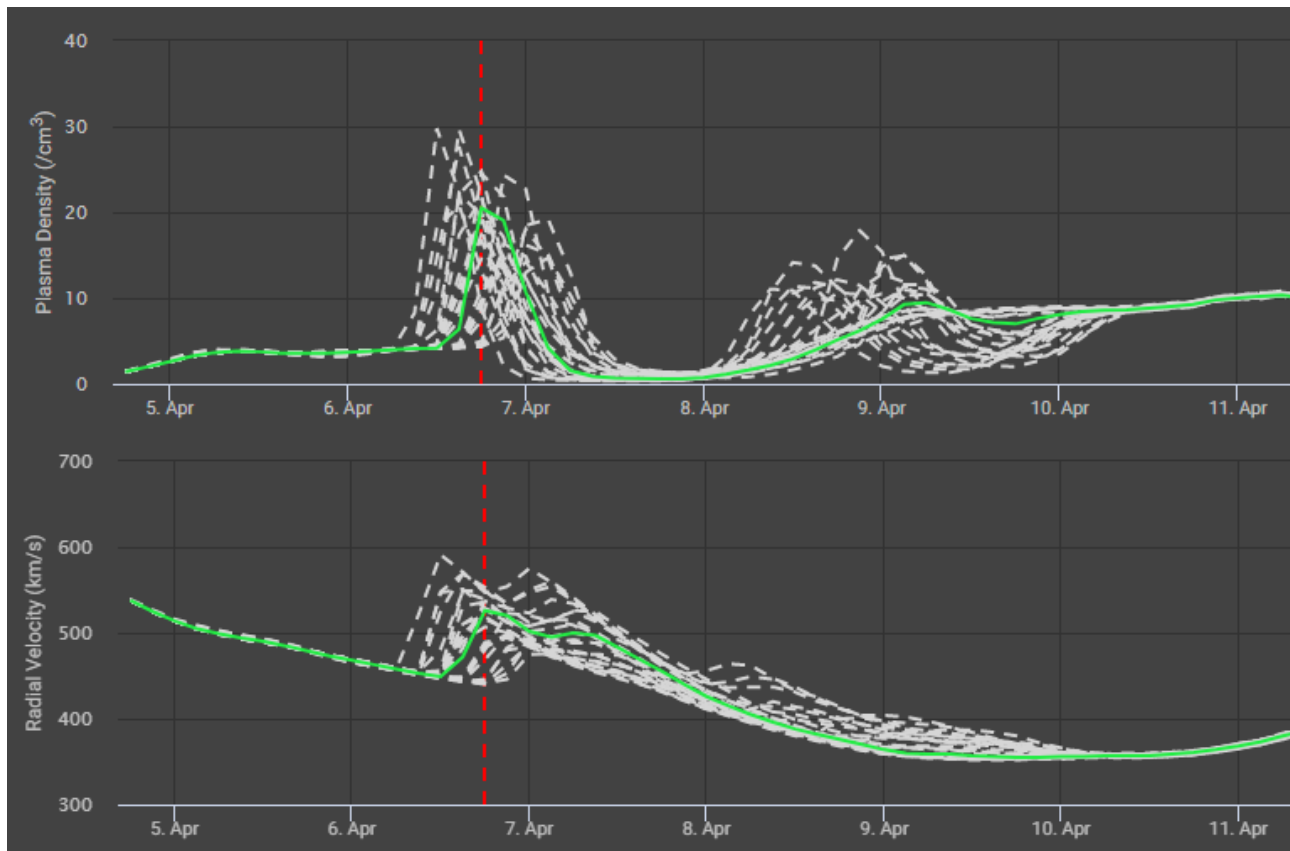
Geomagnetic activity is forecast to become Unsettled to G1/Minor Storm early on day 1 (7th), with a chance of a G2/Moderate Storm interval, due to the CME arrival. Quiet to Unsettled conditions are then likely to return on day 2 (8th), before a further enhancement to Unsettled to Active levels is likely later on day 3 (9th) into day 4 (10th) as CH72/- moves into a geoeffective position. There is also a chance of G1/Minor Storming during the CIR and initial onset of the high speed stream.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	60	20	40	20
Strong	G3	No	5	2	2	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
03/2240 UTC	Halo	Filament eruption	7S, 8W	595 km/s	06/1600 UTC	Late arrival. Limited shock expected.

Figure 2: Enlil ensemble for CME arrival at Earth.



Radio Blackouts - X-Ray Flares:

Solar activity is currently Low, with four sunspot regions on the disc. The largest of these is AR2978 (Chi/Beta), in the southwest, which has grown longitudinally but remains stable. Solar activity is expected to be Low or Very Low over the coming four days. There is a slight chance of it increasing to Moderate levels with isolated M-class flares. AR2978 is the most likely source of this activity, therefore the risk reduces later in the period as this region rotates round the western limb.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	10	5	2
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as measured by GOES-16 at GEO is at background levels. It is expected to remain at this level during the forecast period, but there is a very slight risk of proton storms as AR2978 (currently the most complex sunspot region on the visible disc) rotates towards the west limb, and EX2975 and EX2976 (known proton sources) continue to rotate away from the limb on the far side.

Radiation Storms	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{s}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq \text{S1}$	No	2	2	2	1
Very Active	$\geq \text{S3}$ *	No	1	1	1	1

* S3 $\geq 10 \text{ MeV} \geq 1000 \text{ pfu}$ and / or $\geq 50 \text{ MeV} \geq 10 \text{ pfu}$. (pfu = $\text{cm}^{-2} \text{sr}^{-1} \text{s}^{-1}$)

High Energy Electrons Event ($\geq 2\text{MeV}$):

The high energy electron flux (greater than 2MeV), as observed by GOES-16 at GEO varied between Moderate and High levels in the last 24 hours, and in the absence of any other influences would be expected to persist at similar levels through the period. However, the anticipated arrival of the CME on day 1 (7th) is likely to bring a dropout in values, before a recovery to Moderate to High levels on day 2 and 3 (8th and 9th). The arrival of the fast wind of CH72, and low chance arrival of a further CME on the 9th, is then likely to cause a further dropout of values on day 3 (9th), before a recovery towards the end of the period.

The associated 24 hour electron fluence is currently Active (above $1\text{e}8 \text{ pfu}$), but expected to fall below during day 1 (7th) due to any drop out that occurs from the CME arrival. Although temporary rises are possible thereafter, they aren't thought to be large enough to breach the Active threshold.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	Yes	100	20	20	10
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 3: GOES 16 >2MeV Electron flux and integrated fluence, with REFM data.

